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Downhole construction process for a perpendicular lateral hole

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Downhole construction process for a perpendicular lateral hole

Background of Invention

[0001] Lateral hole has become a new method to construct well in the oil & gas industry. With this technique, lateral hole allows to access some extra zones of the hydrocarbon reservoir. This method is proven to be useful in the case of high hydrocarbon viscosity, low permeability formation, and highly layered reservoir...

[0002] However, the current process to drill these lateral holes and to install completion is quite complex and limit their use. Another limitations of this technique is the accuracy in the placement of the lateral drain as these drains are drilled following short radius curve to reach the direction of the lateral: the drilling is often performed with flexible motor. With short radius build-up section, the curve radius is not well controlled so that the lateral hole may not be positioned in the zone of interest. It would be a major improvement to drill the lateral a right-angle from the main hole, to insure optimum placement.

[0003] Furthermore, with conventional side track technique (and the radius of build-up section), the intersection between the lateral hole and the main well is a long ellipse which reduces the stability and the strength of the main hole, even if it is cased. The opening of the case window (if the main well is cased) is always difficult and a fair amount of metal filings and cuttings is generated with the risk of damage to critical components such as the BOP.

[0004] Right-angle drilling is today not feasible as not tubular can be pushed in the extreme sharp curve. Furthermore, this sharp change of direction prohibits the use rotary drilling. Also it would be even more difficult (or even impossible) to install casing, screen and completion in such a well at right angle from the main well.

[0005] It has also to be observed that in some new well drilling technique, casing has been used as drill-shaft (casing drilling). Large tubular (casing) is used during the drilling process of the well: then it is cemented in place as conventional casing. With another new techniques for well construction, the casing and/or the screen may be expanded to insure a larger bore inside the well. These expansion processes typically required high energy as typically the metal of the tubular is deformed circumferentially in plasticity. Today, casing drilling process has not yet been combined with SET application (Solid Expandable Tubular). It has also recognized that the combination of lateral hole, casing drilling and/or tubular expansion is extremely difficult.

[0006] Tubular for any oil & Gas well purposes are constructed by complex processes within factories to insure high quality of the product. However in some other industries, tubular could be built in-situ on demand by different processes such as metal sheet wrapping and local jointing by for example spot welding or lip forming and pressing. Small tubular could also be obtained by plastic cold forming or extrusion on demand.

Detailed description

[0007] As the main application of the described process is related to oil & Gas well, the terminology of that business will be used. The construction is performed by a machine operated via a wireline cable. The lateral hole is drilled in rotary mode by a small bit. The rotation, the torque and weight on bit (axial force) are transmitted onto the bit via a drill string. One of the main objectives of the proposed system is to insure that the lateral hole is connected nearly perpendicularly to main well.

[0008] The right angle connection between the lateral hole and the main well offer multiples advantages:

- If the purpose is to increase the contact with the reservoir, the lateral can be inside the hydrocarbure layer over its full length of the lateral.
- This right angle exit from the main well removes the main risk of the short radius drilling which is the landing of the lateral hole in the wrong layer (typically the water), as the radius of the curve to reach the proper horizon for the lateral is difficult to predict.
- The planning for the lateral drilling is easier, as the lateral drilling can be directly performed at the depth of the zone of interest (no entry curve).
- The right-angle lateral is shorter than the short radius lateral to reach the same remote target. This reduces the friction loss in the lateral during production of oil, allowing more flow for a given lateral diameter.
- The connection between the lateral and the main hole is quite more stable than with conventional directional drilling practice. With the conventional side-track, the lateral intersects the main well over a long ellipse (the long axis could be more than 10 meters). This means that the well hole appears to have a long axial cut. In this zone, the circumferential stress (either due to lithilogy effect, or pressure effect) are not supported properly: this may turns into hole collapse (or occasionally into fracture).
- If the main hole has a casing, the radial drilling concept allows to remove less casing, as only of circular hole is needed. Minimum of metal needs to be machined down-hole: this is a critical time saving and minimize the risk of leaving metal filings in the well with risk of damaging well components.

[0009] The proposed process allows the completion of the lateral with a cemented casing or expanded screen (and/or casing). The completion is made from the same tubular structure being used for the drilling. This insures no need of pulling out of the lateral and no need of re-entry in the lateral.

[0010] If the lateral is constructed from an already cased & cemented main well, both holes can be jointed by multiple technologies: the junction is relatively simple as the lateral intersects the hole following a small radial circle (an not a long ellipse).

[0011] It should be noted that the lateral drilling & construction could be performed in a single wireline run which combines logging tools to locate the hydrocarbon.

The right-angle lateral and its construction

[0012] When the wireline machine is at the proper depth in the hole, the construction process starts by orienting the wireline machine so that the radial drilling direction is correct versus the lateral trajectory. This orientation may be operated by a moving the tool up and down around the proper depth, to that the torque generated by the typical cable twist rotates the tool.

[0013] Special equipment may be added in the string to insure the orientation of wireline tool, such as powered swivel which may be equipped with friction pads to counteract the tool rotation torque. Other rotating devices could also be used but are not described here.

[0014] When the tool is at the proper depth with the proper azimuthal position, the drilling of the lateral hole starts. If the cable is considered not rigid enough to keep the position during the full operation, it may be needed to clamp the tool in the well.

[0015] If the operation is performed in a cased well, the first step is to drill the circular window in the casing and the cement. This could be performed by a different drilling head that the head needed for the drilling of the lateral. Some wireline radial drilling tools already use this concept.

[0016] Then the drilling of the radial starts. Rotary drilling of a hole by a bit requires the following combination:

- The bit must be rotated at a certain RPM to insure the proper actions of the "cutters". The cutting action can be either shearing, gouging or abrasion.
- The bit must be pushed in contact with the material to drill so that the cutters may interact properly with the material to drill. An axial force must be applied onto the bit. In the oil & Gas drilling industry, this is called Weigh-On-Bit (WOB).
- As a reaction to the WOB (via the friction of the bit), a torque is required to rotate the bit. This torque depends on WOB, RPM, material to drill, and properties of the bit, as well as the potential lubrication action due to some fluid (if present).

[0017] A possible design is shown in Figure 1 which is the support for the following description. Rotation, torque and axial force are generated inside the wireline tool. A motor and a transmission rotate the drill sting. The axial force (or WOB) is transmitted from a pushing system to the string via a lever system. A short shaft terminates the drill-string inside the wireline tool: this short shaft is a part of the wireline tool (Figure 2). It latches in the drill string by slip or locking systems and performs sealing. The slips allow to transmit axial force (push or pull) and torque. The seal of short shaft allows flow connection between the hollow part of short shaft and the drill-string. This flow is needed for the drilling process and

can be generate by a pump inside the wireline tool: typically the circulated fluid for the drilling process is the fluid contained in the main hole.

[0018] In Figure 1, it is also shown the stack of rolled band of metal that will be needed for the tubular construction. One of the roll is loaded on the short shaft to become the active roll for the current construction process. While the drill process proceeds, the tubular is pushed in the lateral hole by the short shaft. This means that the end of the already constructed tubular is moving towards the outside of the machine following the short shaft. In a synchronous fashion, the active roll wraps metal band around the drive shaft: for this purpose, the active roll has a rotation speed different from the drilling tubular. The final step of the construction is the jointing process between successive wraps. The jointing can be achieved by spot welding, pressing of lips, … This will cover in the next section.

[0019] Other tubular production processes could be used inside the wireline tool to achieve a nearly continuous process: some of them will be covered in a lower section. With any proposal, just before leaving the wireline tool, the drill shaft construction is finalized to become a continuous tubular from the bit to the exit of the wireline tool (which is the starting point of the lateral hole).

[0020] The tubular has a large diameter in comparison of the diameter of the lateral (may be 2.2 inches tubular for a drill bit of 2.5 inches). This makes the tubular quite rigid in bending and torsion, allowing to use thin wall pipe. As an example, the 2.2. inches diameter tubular may have a wall thickness probably quite less than 1 mm; it may even be as small as 0.1 mm.

[0021] Again thanks to the large diameter and geoimetrical inertia, the shaft resistance to buckling is high. In any case, as the tubular diameter is large compared to the lateral diameter, the lateral deformation of the tubular stays small.

[0022] When the lateral hole is drilled to its required length, the rotation is stopped. The tubular is left in hole (with the bit and any guidance systems if any). The tubular is become the casing or the slotted liner (or even the screen).

[0023] For the section to be cemented (the tubular is considered as casing), a cement fluid will be pumped into the annulus of the lateral. If it is a slotted liner, it can be expanded. In the section facing the production zone, communication between the formation and the inside of the tubular is achieved by an internal wall protection. More details will be given in next section.

[0024] Finally the tubular is sheared at the intersection between the lateral and the main well. The word "tubular" is used in the description, as it is initially the drill-string. It then becomes the casing or slotted liner. But as production will be performed directly inside the same pipe, it could considered as the tubing (however, it is normally not removable).

The lateral-hole tubular

[0025] With this invention, the tubular used to drill the lateral hole is constructed down-hole from a reserve of material stored inside the wireline machine. With the preferred application, the material is initially a rolled band of material. The material could be thin steel rolled band: however other metal (such as aluminium) or "plastic" (synthetic material) could be considered.

[0026] The primarily motivation of the down-hole construction of the tubular for the lateral hole is to insure that the lateral hole is perpendicular to the main well. With this right angle requirement and the typical well geometry, it is extremely challenging to enter some components in the lateral hole. Long components (such as conventional slim drilling motor) cannot enter the side hole. Furthermore, the drill-shaft design and driving mechanism (rotation, torque and pushing effect) required even more attention, as it is extremely difficult to slide and rotate a tubular in the lateral hole.

[0027] For reference, the diameter of main well is typically 7 inches; the diameter of lateral hole can be typically in the range of 2 to 5 inches. With this invention and with a wireline construction tool, the optimum lateral diameter could between 2.5 and 3 inches (however, this range is not a limit). The lateral constructed by this new process could extend over 100 and even may-be longer 300 ft.

[0028] With these typical dimensions, the diameter of tubular for the lateral is typically between 1.5 and 2.2. inches. As the tubular is initially the drill shaft for making the lateral hole, it has to rotate, transmit torque and axial force to the drill bit.

[0029] Another advantage of down-hole forming of the tubular is the compactness of the wireline machine and storage of the material: it is estimated that the rolled sheet is typically 20 folds shorted than the finished tubular. This means that it may be foreseen that the machine could be approximately 15 meters, including the storage length (probably 2 to 5 meters) for tubular material. This storage could allow to construct the tubular for more than 100 ft lateral well.

[0030] This is a considerable advantage for handling of the machine at the surface. The loading and the unloading of the machine in the well is typically performed with a crane and not with a drilling rig. The handling is directly performed above the wellhead as for production wireling logging.

Construction of the tubular

[0031] As a main part of this invention, the tubular to construct the lateral (from drilling to production phase) is fabricated down-hole by the wireline machine. In the prefer embodiment of the invention, the fabrication of the tubular is performed by the continuous wrapping of a band of metal following a spiral (Figure 3). With this process, the metal band is jointed following the spiral edge of the metal band. This process is commonly used to fabricate pipe and tube for sheet of metal. The

novelty resides in the down-hole fabrication of tubular in a continuous process to feed in the (nearly) simultaneously drilled lateral hole.

[0032] For the wrapping, multiple process may be applied. In one process, the wrapping is performed continuously while the tubular rotates and advances outside the tool to insure the drilling. The active storage roll rotates nearly at the same speed as the rotary speed. Only as small differential speed is needed as the bit needs a lot of turns to penetrate the rock of a distance equivalent to the width of the metal band. The differential rotation could be obtained by a brake system connected to the active storage roll. With this approach, the joint make right-hand thread around the tubular when the tubular is driven to the hand for drilling. For some applications, it may be beneficial that the tubular joint make a left-hand thread when rotated to the right. In this case, the active storage roll needs to be rotates slightly faster than the tubular in rotary drilling.

[0033] For both directions of wrapping, the wrapping could be performed when the rotary drilling is stopped. In this case, the active storage roll needs to be rotates slightly faster than the tubular in rotary drilling.

[0034] For both directions of wrapping, the wrapping could be performed when the rotary drilling is stopeed. In this case, multiple wrapping turns are typically done in one step to generate a tubular length similar the wireline tool diameter. For any wrapping process, it is critical to generate the spiral for the joint: either the tubular is axially displaced or the roll is move backwards during the wrapping process.

[0035] The jointing could be performed by welding. The welding has to be performed under the presence of fluids (drilling mud or completion fluids). The presence of fluid (which may contains particles) is a problem for most welding process due to loss of heat (which may prohibit to reach locally the metal point of metal), and the pollution of liquid metal for the fluid molecules and its particles. Furthermore, the fluid should normally change phase (due to extreme temperature

near the melted metal): this would corresponds to large volume change of the fluid, with large perturbation of the "atmosphere" near the welding. Spot welding may be the preferred solution, as the process start by pressing the sheets of metal against each other, rubbing the surface sufficiently to remove potential large volume of potential pollutants (such as mud particles). With this process, the zone of melting is extremely small (just at spot of contact between the 2 plates). The pressing electrodes may be surrounded by ceramic to insure limit current loss if working in conductive fluid, but also to limit the heat loss during the passage of the large current. Electrical Spot welding is attractive as it should be not too sensitive to pollutants. A drawback is the limited fluid sealing at the joint. This fluid sealing could be improved by limiting the distance between welding spots. Additional sealing could be achieved by the use of seals or sealing agents. A potential solution (Figure 4) for the use of seals is to start with a metal sheet that has two bands of sealing agent (rubber type materials) at each edge. The spacing of the two seal band is sufficient for allowing spot welding in-between them. After welding, the welded spots hold the successive sheet in contact while the rubber band play the role of sealing (such as a gasket).

[0036] As an alternative to spot welding, permanent plastic lip pressing could be used. The pressed lips should have the adequate pattern for proper jointing. Figure 5 shows a potential solution. The band on the roll may already have both edges bend as U-shape facing the opposite side of the band. The wrapping would then be performed with too much overlap (the spiral angle is too small). Then, a wrapped sheet is extended axially to engage the U-shape lips on the spiral. The assembly process is completed by hard pressing of the lips to force them in solid contact. As the pressing can be continuous over the spiral, constant-joining properties may be achieved. With adequate care, pressing force and proper material, it is possible to make a sealed joint. The seal could even be improved by the addition of thin deformable layer on one side of the sheet. This layer could be a thin layer of

"plastic" material. Thanks to the presence of this plastic deformable layer, the surface finish of the metal sheet does not need so perfect, and the process may even accept that the surface in contact are slightly covered by particles (as in mud).

[0037] Note: the described jointing process is similar as the one for the lid of food can.

Rotary drilling with the constructed tubular

[0038] With the described embodiment, the rotary drilling is performed by successive steps involving bit penetration equivalent to the distance slightly shortly than the tool diameter. This is mainly due to the need to change the position of the tubular holding mechanism.

[0039] As the storage roll stays always with their axis parallel to the tool axis, these rolls can have a large diameter, which allows a good usage of machine volume. Furthermore there is less handling of these rolls.

Completion techniques of the lateral hole

The cemented and perforated casing

[0040] When drilling is completed to insure the proper length of the lateral hole, the drill-string is left in the hole to become the casing. The tubular is released at the intersection with the main well, by shearing the last wrap of the metal band.

[0041] With some designs of the wireline machine, slurry can be pumped into the annulus between the tubular and the lateral hole. The slurry can placed in either direction depending of the ease of the process (and the design of the wireline machine). The description of the slurry placement is not part of this invention.

[0042] After the cementing operation of the tubular, isolation is achieved in the annulus of the tubular. It is then required to generate a communication between the hydrocarbon reservoir and the lateral well. This communication is typically

required either over the last section of the lateral (which intersects the production zone) or the full length of the lateral. To avoid perforation process (typically with shaped charges), the tubular over the zone of communication with the reservoir could be a strippable slotted liner (this is described in next section): this section is not cemented (Figure 7).

[0043] This means that the tubular constructed during the drilling process may consist of different sections. Typically, the first section behind the bit may be made as strippable slotted liner followed by a solid wrapper tubular.

The strippable slotted liner

[0044] The strippable slotted liner is constructed by jointed wrapped band as described above. The difference is the structure of the band (Figure 8). The edge of the band are exactly as described above to insure the jointing.

[0045] The middle of the band is the difference between a solid tubular and this strippable slotted liner. For this application, the band consists of two layers. The external layer (in reference of wrapped tubular) is the main band as with the solid tubular: slotting is being made in the none-overlapping zone of the band. This slotting is typically performed at the factory before the band loading onto the storage roll. The slotted area is covered by a thin layer of material to insure fluid sealing across the tubular. This layer guides the flow during pumping over the length of the tubular and the annulus. This thin layer can be stripped or peeled off when drilling is finished, and drill-fluid flow is not required anymore. The peeling or stripping could be performed by pulling on a cable attached to end of the strippable layer near the bit (Figure 9). It should be noted that the cable is initially attached to the tip of the stripping layer: the cable is fed through the short shaft during the wrapping of the tubular over the whole drilling phase. Also it is important to notice the stripping layers of the successive sections of the constructed tubular from various band storage roll have to be interconnected to

insure the stripping over the multiple sections. This can be performed by insuring that the joint from band to band (when changing storage rolls) is performed via the strippable layer and not the basic bands. In that case, some overlap from band to band may-be needed: this requires that up to 3 layers of metals be jointed by their sides, requiring more pressing force from the jointing tool. Fluid sealing (for the drilling process) is achieved at the successive band joint by the joint between the stripping layers.

The expanded tubular

[0046] With small holes, it is critical to insure that flow section in the well is as large as possible. This can be achieved by expanding the tubular that was initially used for drilling. The expansion is achieved by un-wrapping the tubular after breaking the spiral joint. For this objective, the tubular wrapping was initially performed with a spiral to the left hand side. This insures that drilling torque generates tensile load in the band, while the spiral joint is in compression (in approximation of the principal stresses due to drilling torque): another way to perceive this situation is that the drilling torque has tendency to reduce the diameter of the tubular, if the spiral join was loose. To insure higher efficiency of this process, the initial wrapping has to be performed with left hand spiral (which requires active rotation of the storage roll); furthermore, the wrapping has to be performed by feeding the band from the inside of the already wrapped tubular (which is more complex than the conventional feeding by the outside). With this wrapping technique, a left hand torque has the effect of setting the spiral joint under tension so that the tubular would increase its diameter is the spiral joint becomes loose.

[0047] The expansion process is performed by the following steps:

- The bit end of the shaft is anchored in the formation. This can be performed by one of the three following actions:

. High WOB so that the bit cannot rotate anymore.

. Cementing of the bit end of the tubular, to anchor the bit end in the formation.

. Mechanical deformation of the tubular by pulling one the central cable (similar cable as being used to strip the screen). By pulling on this cable, a set of arm deform the end of the tubular into an oval which get stuck in the hole.

- Left-hand torque is applied onto the tubular by the rotary drilling motor. This torque has the tendency to open the tubular, by "cracking" the pressed spiral joint (Figure 10).
- As the tubular opens, the tubular circumference increases: this requires more band length per turn. To keep proper coverage (and overlap between the successive band), it is required to push the tubular slightly in the hole per expanded section. This means that while the tubular is being unwrapped, starting at the bit end, new tubular has to be constructed inside the machine.

[0048] Depending on the elasticity of the band material, the unwrapped tubular may be stable (if it was in elastic deformation in jointed tubular): with this situation, the band "sticks" at the wall. However, the reverse situation may also exist: then expanded tubular may desire to close towards the inside: in that situation, it is required to lock the other end of the band when finishing the expansion. This could be achieved by cementing the final end (near the main well) of the tubular (without expansion).

[0049] Another method is to use a slightly more complex jointing surface which would insure that the tubular could opens when left-hand torque is applied; while it cannot close with right-hand torque. This can be achieved with the jointing

pattern defined in Figure 11. This part of the joint would act as the reverse effect of a conventional wire tie-wrap.

The combined slotted liner and casing

[0050] As already mentioned, it may be most beneficial to combine multiples possibilities of the tubular for the completion. Examples:

- The tubular section near the bit could be a slotted tubular, while the tubular near the main well could be expanded to play the role of an expanded casing for large well flow. This is quite useful to access hydrocarbon zone not connected to the main well.
- The slotted liner could also be expanded to insure large axial flow in the well, and simultaneously to support the sand-face.
- For proper expansion process, the end of the well (near the bit may be cemented to resist to the left hand-torque required to start the expansion process.

[0051] To achieve these combinations, the band of the storage roll needs to be properly selected. Furthermore, the storage rolls need to be mounted in the proper order into the machine.

[0052] The tubular needed for drilling the small diameter lateral hole could be obtained by joining multiple short pipes together. Typically, the short pipe section should be smaller than the tool diameter, so that it can be aligned with the tubular already in the lateral well (this tubular is typically perpendicular with the tool axis). Drilling torque and WOB could be applied to the last pipe still in the wireline machine by a set of rotary jaws as used in lathe: with lathe jaws, torque and axial load can be applied. If threat is used between successive pipe sections, it is critical to avoid galling, as the environment can be quite dirty. If the tubular can be left in the hole after drilling, threat could be replaced by matching surfaces

which could be blocked into each other forever: a simple solution would be based on cones of small angle. Cone assembly is typically used for small high speed flywheel on drive shaft to insure good centralization: with the proper angle, high torque can then be applied: Disassembly is often difficult and requires either special extraction tool or impact tool. System with interlocking mechanism could be also considered.

[0053] Another approach to generate the pipe section (or the tubular) is to cold form the pipe section from block of metal. This could be obtained by pressing technique or extrusion process.

[0054] This invention is about a method to construct tubular in-situ and on demand to insure the drilling and construction of well.

[0055] The construction of the tubular may be performed down-hole in an already existing well.

[0056] The construction may be performed inside a down-hole drilling machine to drill or complete a new hole section.

[0057] The drilling machine drills a side hole to the main existing.

[0058] The side hole may be perpendicular to the initial main hole.

[0059] The tubular construction may be performed by wrapping band of material.

[0060] The band may be wrapped into a spiral and jointed.

[0061] The jointing is performed by spot welding.

[0062] The fluid sealing is achieved after the jointing, so that the tubular can contain fluid.

[0063] The sealing is obtained thanks to the use of thin bands of sealing material deposited in parallel lines near the edge of the band before the jointing.

[0064] The jointing is obtained pressing matching preformed lips of the edges of the band.

[0065] The band for constructing the tubular is stored on multiple rolls.

[0066] One roll of the stack of storage roll may feed the band for constructing the tubular, until being emptied. Then another roll starts the feeding process.

[0067] The bands of 2 successive feeding rolls may be jointed end to end, to allow construction of long tubular.

[0068] The end to end band joint may be performed by spot welding or lip pressing.

[0069] The tubular construction process may be performed in synchronous or semi-synchronous fashion with the advancement of the tubular in the lateral hole.

[0070] The constructed tubular may be used as a drill-shaft to drill a lateral hole at nearly perpendicular direction to the main well where the machine stays installed.

[0071] The tubular may be left in the drilled lateral hole after the drilling process.

[0072] The tubular may be cemented in the lateral hole as permanent casing.

[0073] The cementing may be performed only over certain length of the annulus of the lateral hole.

[0074] The tubular may be formed from a proper band structure so that the tubular could act as slotted liner in the lateral hole.

[0075] The tubular wall is constituted of a slotted layer which is also the main structure of the tubular with an internal layer, which can be stripped on demand.

[0076] The internal strippable layer insures fluid sealing integrity across the tubular wall, when still properly installed at the wall surface.

[0077] The tubular made of slotted liner band and internal covered with the strippable layer can act as drilling tubular and insure fluid flow for the drilling process.

[0078] The internal layer may be stripped after the drilling process to allow connection between the formation reservoir and the inside of the tubular, allowing the tubular to support production from the reservoir.

[0079] The tubular can be expanded in the lateral hole.

[0080] The tubular may be expanded by unwrapping the band forming the tubular.

[0081] The unwrapping may be achieved by starting from the deep part of the lateral (last drilling section).

[0082] The unwrapping may be achieved by applying left-hand torque.

[0083] The deep part of the tubular may be locked in rotation in the lateral hole.

[0084] The locking may be achieved by cementing a short length of the annulus in the deep part of the hole.

[0085] The locking may be achieved by oval deformation of the tubular at the deep point of the hole.

[0086] The oval deformation may be performed by pulling on radial arm system at the deep point.

[0087] The pulling action on the arm system may be achieved via a cable inside the tubular.

[0088] The cable may be installed during the construction of the tubular.

[0089] The wrapping may form a left-hand spiral with the band being fed from the inside of the already constructed tubular.

[0090] The lips overlap may include narrow teethed surfaces parallel to the edges of the band and at small distance from the edge.

[0091] The teethed surfaces interact between each other after the jointing process, to increase torque transmission capability in one rotation direction.

[0092] The teethed surface may allow the band to slide between each other to increase the diameter of the tubular.

[0093] The teethed surface may expand with application of the torque in adequate direction, while the tubular cannot come back towards its initial geometry after the expansion process.

[0094] The tubular may be used in different mode in production phase.

[0095] The tubular may act as cemented casing over certain length, while being a slotted liner over other length; and certain section can be also expanded.

[0096] The tubular may be constructed from short pipes added to each other to form the long tubular.

[0097] The short pipes may be screwed to each other by threads.

[0098] The short pipes may be attached by cones which are forced in each other.

[0099] The short pipes may be mechanically latched in each other.

[00100] The short pipes may be obtained with cold forming process performed down-hole.

[00101] The pipes may be extruded down-hole.

[00102] The pipes may be obtained by pressing block on material into the proper matrix.

Claims

[c1] A method for a downhole construction of a lateral hole departing from a main well, comprising:

- positioning a drilling machine at a determined depth in the main well;
- drilling the lateral hole in a direction perpendicular to a longitudinal direction of the main well.

Abstract

Downhole construction process for a perpendicular lateral hole

This invention is about a down-hole construction process of a lateral hole from an already existing main hole. With the proposed process, the lateral hole is connected perpendicular to main the main hole. The lateral hole is drilled and completed in one continuous operation under the control of a down-hole remote controlled machine operated by a wireline-cable. The lateral is drilled directly with the completion hardware (casing, sloteed liner or screen). The completion tubular hardware is formed down-hole from rolled band of metal. In some application, the completion tubular can be expanded against the formation. Other down-hole construction processes of the tubular are proposed.

The invention covers the down-hole construction machine as well as the process to construct the lateral. The described processes and machines apply primarily to the drilling of lateral hole in the oil & gas business. It also applies to any other industries where it may be advantageous to connect a secondary hole to an existing one.

Figure 1

Right-angle drilling & Shaft forming machine

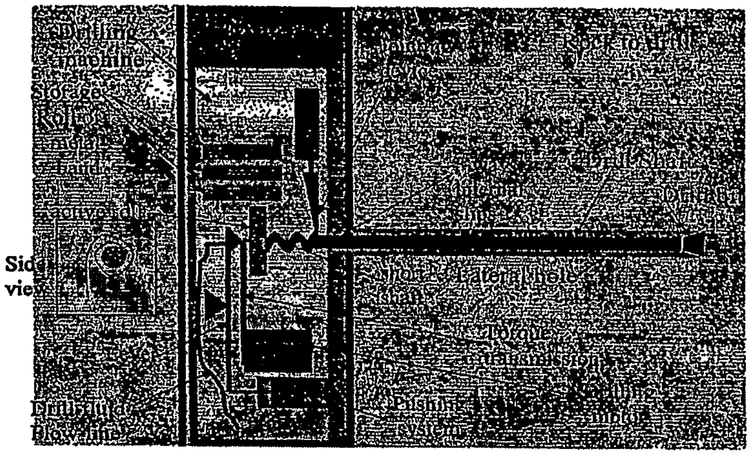

Figure 2

Link between the tubular and machine

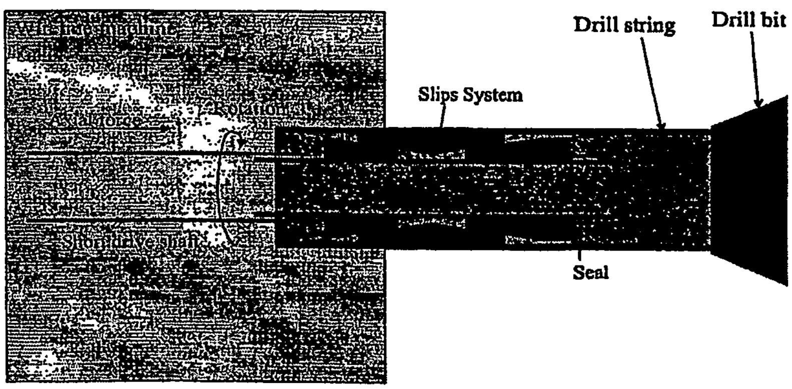

Figure 3

Construction of the tubular

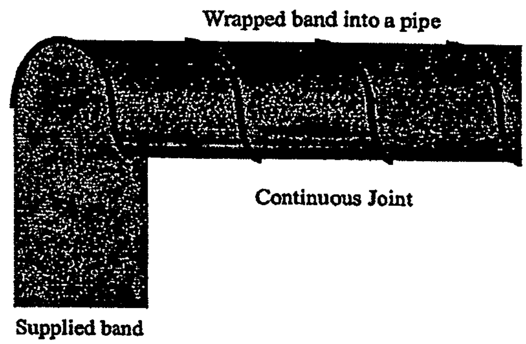

Figure 4

Band for sealed spot welding process

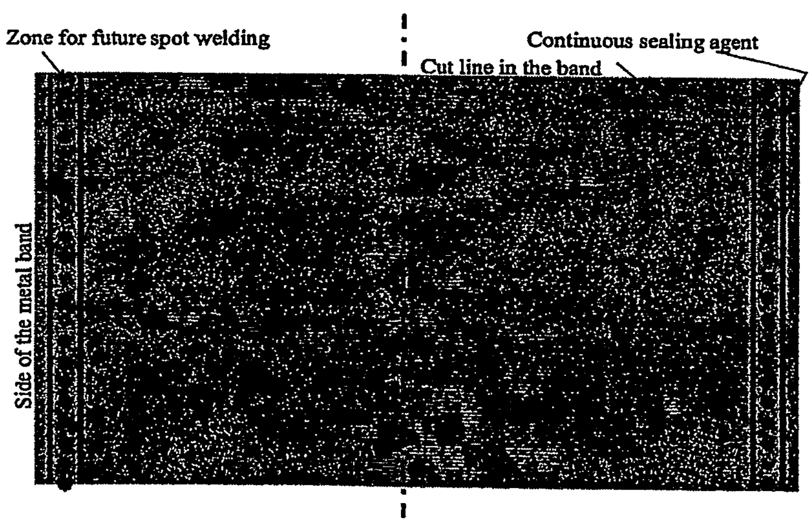

Figure 5

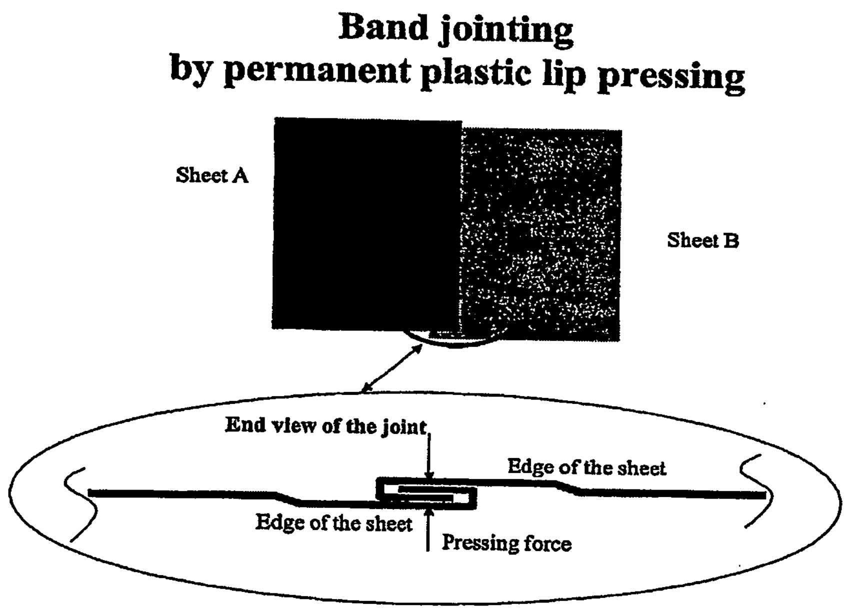
Band jointing
by permanent plastic lip pressing
Sheet A
Sheet B
End view of the joint
Edge of the sheet
Edge of the sheet
Pressing force

Figure 6

The machine with wrapping process at 90 degrees

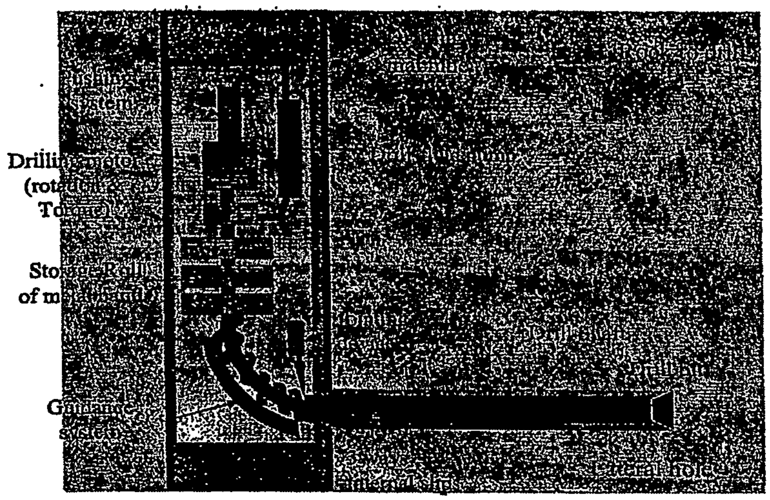

Figure 7

Completion in the right-angle lateral

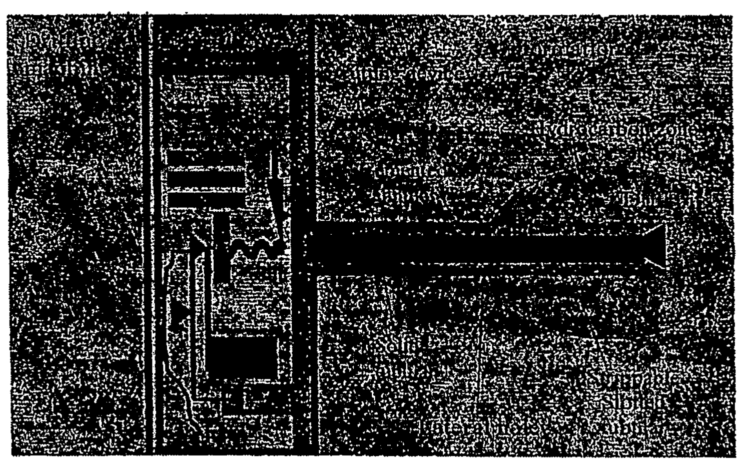

Figure 8

The band for the strippable slotted liner

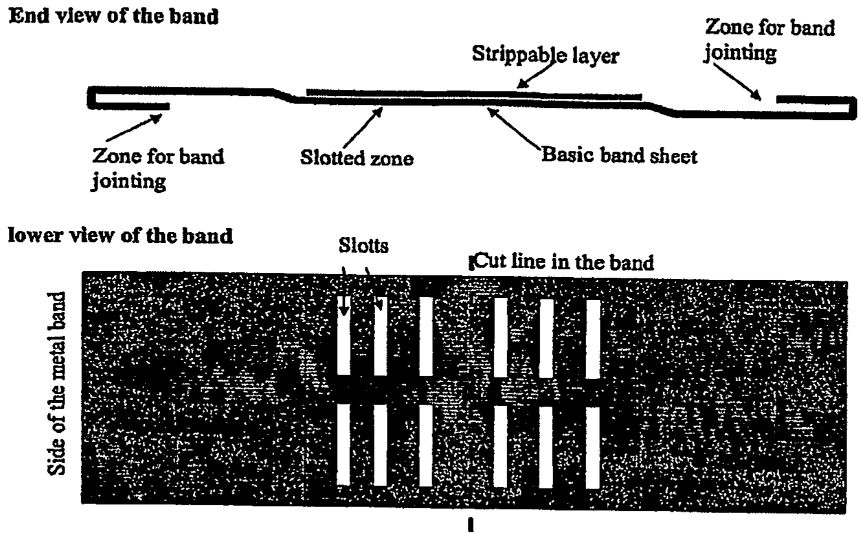

Figure 9

The stripping of the slotted liner

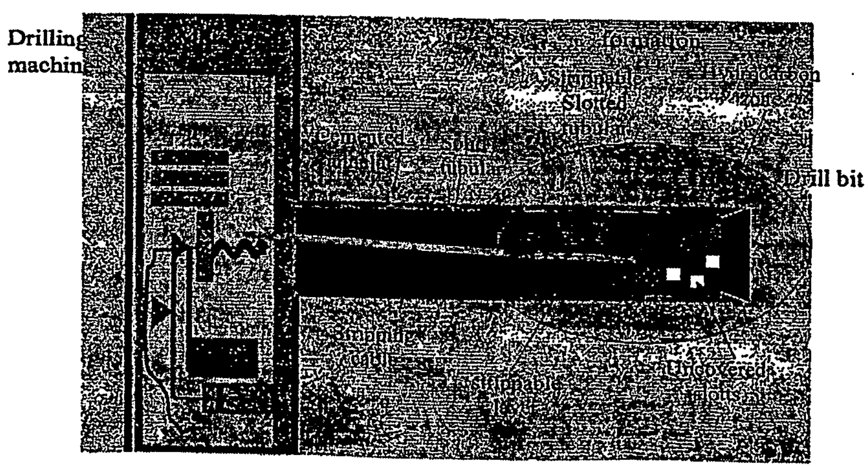

Figure 10

Tubular Expansion by unwrapping from the bit end

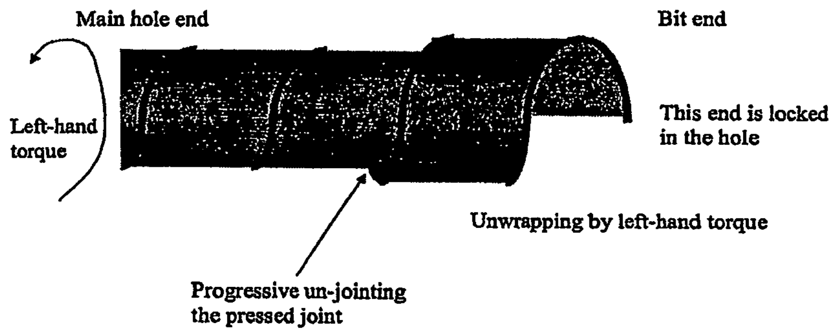

Figure 11

Band jointing with ratchet effect for latched expansion